the condition of persons afflicted with ptosis; and I have therefore considered it advisable to direct attention to this subject. I must, however, mention that, in the *Lancet* of 23d September 1871, a case of Mr Brudenell Carter's is shortly alluded to, in which, after an iridectomy had been made upwards in both eyes, the resulting pupils were so much covered by the upper lids as to be of little use. Mr Carter had then recourse to division of the superior, internal, and external recti muscles, "so that each cornea was pulled downwards by its inferior rectus, the eyeball was rendered more prominent, and the artificial pupil was brought opposite the palpebral fissure." In a note I have received from Mr Carter, he states that he is in the habit of adopting this treatment in cases where the lower portions of the cornea are permanently opaque, and has found it to answer well, and mentions that it was suggested to him by Mr Bader. I am, however, unable to see any decided advantage that can be derived from the division of the external and internal as well as of the superior rectus.

ARTICLE III.—*On the Differential Stethoscope, and its Value in the Diagnosis of Diseases of the Lungs and Heart.* By GEORGE L. CARRICK, M.D., L.R.C.S.E., and L.R.C.P.E.; Physician to the British Embassy at St Petersburg; formerly Resident Clinical Assistant at the Brompton Hospital for Consumption and Diseases of the Chest.

OF the numerous, almost numberless, stethoscopes which have been invented since Laennec's time, none has proved of more practical value to the auscultator, or of greater interest to the acoustician, than the differential stethoscope. It has enabled the former to arrive at a correct diagnosis in many cases of thoracic disease, where, without its aid, he would have been in doubt, or even error; while to the latter it has demonstrated certain interesting laws regarding the sense of hearing. The instrument, moreover, is very portable, simple in construction, inexpensive, and, to those who are acquainted with the uses of the ordinary stethoscope, not difficult to master. These are merits sufficient to recommend it to the notice of every auscultator. But, strange to say, although most physicians know Dr Scott Alison's stethoscope by name, many have not seen it, few have used it, and fewer still have taken the trouble to learn its use. Now, this neglect of a most valuable aid to diagnosis is due simply to the fact, that the qualities of the instrument are imperfectly known. Indeed, the acoustic principle upon which the differential stethoscope is constructed is so little understood, that many experienced auscultators regard the instrument as simply an intensifier of sound. I trust, therefore, that a brief reference to its history, and to the principle of its construction, as well as a more detailed account of using it, and of its merits and

demerits when compared to other stethoscopes, will not be considered out of place.

History.—The principle of binaural auscultation was first demonstrated by Dr Leared, who exposed, at the Great International Exhibition of 1851, an instrument by means of which sounds produced at one part of the chest were transmitted to both ears simultaneously. Dr Leared's stethoscope was made of gutta-percha entirely. It consisted of a hollow cylinder, expanding into a cup (which was applied to the patient's chest) at one end, while to the other were attached two immovable tubes. The free extremities of these tubes ended in circular flat ear-pieces, like those of the ordinary stethoscope. In the same year (1851), Dr Marsh of Cincinnati published a description of a binaural stethoscope, of which he was the patentee as well as inventor. The idea, however, of auscultating with both ears at once, had previously occurred to many physicians, while by some it had been even carried into practice. Dr C. J. B. Williams informed Dr Alison that, many years prior to 1851, he was in the habit of exhibiting to his class an instrument which he had had constructed for binaural auscultation. In all these stethoscopes, however, there was no self-adjustment. Moreover, they were heavy, unwieldy, and inflexible. Their ear-pieces were like those of the ordinary stethoscope, *i.e.*, plane or concave gutta-percha or wooden discs, instead of the small rounded ivory knobs now in use. The latter, by entering the meatus auditorius externus, conduct sound infinitely better than the former, which simply press against the pinna. All these defects detracted largely from the value of what would otherwise have proved most useful instruments, and prevented their introduction into general practice. Binaural auscultation as a practical art may be said to date from the year 1852, when Dr Cammann of New York described his flexible stethoscope.[1] It is constructed upon precisely the same principle as Dr Leared's instrument, but differs from the latter,—1*st*, In having the tube flexible at one part; 2*d*, In small ivory knobs supplying the place of the ordinary ear-pieces; and, 3*dly*, In being kept in position by a movable joint and elastic band, thus leaving the auscultator one hand free. These were improvements sufficiently important to convert an unpractical instrument into a very practical one.

Dr Cammann's binaural stethoscope (Fig. I.) consists of a

[1] Until the publication of the latest (sixth) edition of Professor Aitken's admirable text-book, I had laboured under the impression that it was Dr Cammann who had patented in the United States the instrument known by his name. It appears, however, that it was not Dr Cammann, but Dr Marsh, who had patented a very inferior kind of binaural stethoscope, of which he professed to be the inventor, but which, as Dr Cammann pointed out, had been simply *borrowed without acknowledgment* from Landouzy of Paris; whereas Dr Cammann's valuable and ingenious instrument was freely placed at the disposal of the profession.—See *Science and Practice of Medicine*, by Wm. Aitken, M.D., 6th edit., 1872, vol. ii. p. 497.

wooden cylinder, resembling a dumpy little uniaural stethoscope (A). One end of the cylinder expands into a cup (B), which is applied to the chest for collecting sound, while to its other extremity are attached two tubes (C, C). These tubes communicate with the hollow cylinder, are about 10 inches in length, and consist of 3 inches of flexible (D), and about 7 inches of metallic tubing (E). The former is joined to the wooden cylinder, while to the free ends of the latter the small ivory knobs (F) are attached. The two metallic tubes are connected by a jointed bar (G). "The joint allows of the partial separation and approach of the tubes necessary for adjustment in respect of the ears. A band of elastic material (H) connects the two tubes at a point between the bar and the ear extremities." The auscultator can thus, while keeping his head fixed, move the instrument right or left, upwards or downwards. The mechanism of Dr Cammann's stethoscope served as the model upon which Dr Scott Alison's differential stethoscope was made, although the two instruments are constructed upon entirely different acoustic principles. Before passing on to a description of the differential stethoscope, it may be well to state in what respects Cammann's differs from the ordinary stethoscope; and this is all the more necessary, as we shall presently have to institute comparisons between Alison's and Cammann's instrument. Dr Cammann's binaural stethoscope possesses many advantages over the ordinary one. *Firstly*, By allowing both ears to listen to the same sound at the same time, the acoustic impression is clearer, louder, and fuller. The rule, that a more vivid effect is produced by the use of two organs than by the use of one, is as applicable to acoustics as to optics. *Secondly*, Many fine sounds which cannot be well made out by the ordinary stethoscope are clearly heard by the binaural one. To such belong the fine arrowroot, buzzing, moaning, and indeterminate sounds so often heard in the first stage of phthisis. Crepitation also, whether moist or dry, is better heard with Cammann's instrument. *Thirdly*, The chest can be more quickly and conveniently examined with Cammann's stethoscope, because of the instrument's flexibility.

It is worthy of note, however, that all binaural stethoscopes, from Leared's to Cammann's, are constructed upon the same principle as the ordinary uniaural instrument. They differ from the latter in two points only; firstly, in conducting sound to both ears instead of to one ear; and, secondly, in air being the conductor instead of the material (whether wood, gutta-percha, ivory, or metal) of which the stethoscope is constructed.[1] They all consist of a single collector

[1] Of the distance to which sound can travel through a tube containing air, an interesting case is cited by Professor Tyndall, from "the celebrated French philosopher Biot, who observed the transmission of sound through the empty water-pipes of Paris, and found that he could hold a conversation in a low voice through an iron tube 3120 feet in length."—*Sound*, by John Tyndall, F.R.S., p. 13.

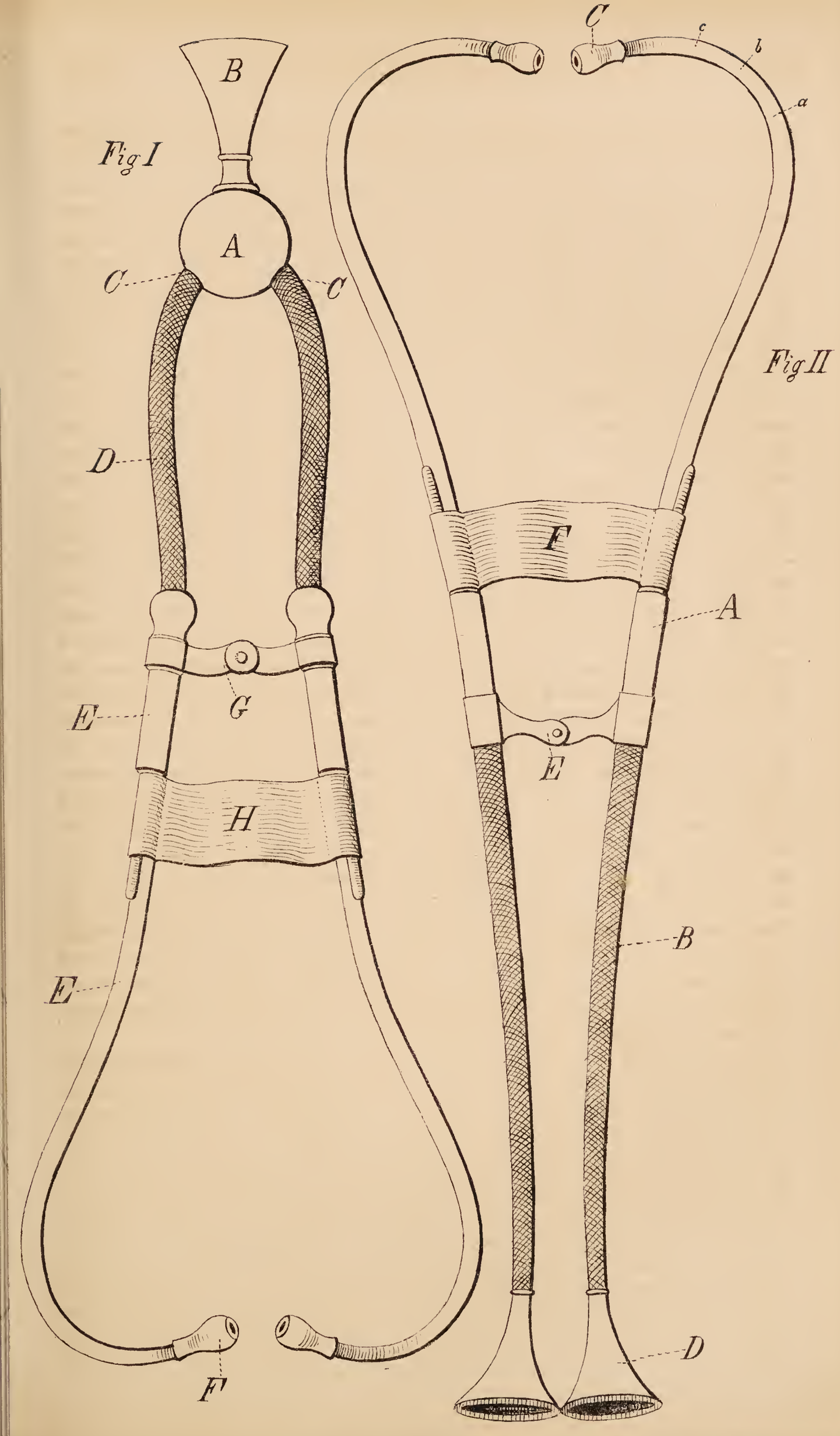
Fig I
B
A
C
C
D
G
E
H
E
F
Fig II
C
c
b
a
F
A
E
B
D

of sound, and of two tubes which carry the sound from the collector to both ears.

All stethoscopes, therefore, whether uniaural or binaural, invented prior to Dr Scott Alison's differential stethoscope, although they differed considerably from each other in construction, were made upon the same principle,—viz., the collecting of sound at *one point only*, and then conducting that sound to one or to both ears. The differential stethoscope, on the other hand, consists of two stethoscopes, perfectly alike in construction, and entirely independent of each other, although joined together for convenience of handling. Of these two acoustically separate instruments, one transmits sounds from one point of the chest to one ear, the other from another part of the chest to the other ear, the auscultator being thus enabled to listen to two parts of the chest at the same time. Now, from *a priori* reasoning, one would naturally suppose that a double stethoscope, conveying sound from two parts of the chest to both ears respectively, could serve no useful purpose if these two sounds were similar, and would only tend to puzzle the auscultator if they were dissimilar. When practically tested, however, the differential stethoscope plainly demonstrates the interesting law in acoustics, that if, of two sounds, of like quality, but varying in intensity, one sound is conveyed to one ear, the other to the other ear, only the major or louder is heard. Thus, a rasping and a blowing sound can both be heard at the same time, the one by the one ear, the other by the other; but of two blowing or of two rasping sounds, the louder one only is heard. When the two sounds are the same in degree and in quality, then we hear them equally well with both ears. The value of this acoustic law, in its application to medical practice, must be obvious to every physician. In auscultating the lungs, he is frequently called upon to compare the intensity of two sounds, and to decide which is the louder; and yet how difficult, almost impossible in some cases, it is to do so correctly with any stethoscope but the differential one! In cardiac murmurs also, how important it is in some instances to determine whether a murmur is louder at the apex or at the base, and how thoroughly even the most expert auscultators are sometimes at a loss to do so; yet with the aid of the differential stethoscope a tyro in auscultation at once hears where the sound is louder. Now if, in the latter case, the ordinary stethoscope, which requires to be shifted from the apex to the base, had been used, the degree of the first sound's intensity would have had time to die away from the auscultator's memory before he heard the second sound, or could institute a comparison between the two. The varieties of sound which the differential stethoscope enables us to compare with each other will be entered upon more fully hereafter. At present it is necessary first to consider,

The Construction and Mode of Using the Differential Stethoscope.—The differential stethoscope was first brought before the notice of the profession in a communication made by its inventor, Dr S. Scott

Alison, to the Royal Institution of Great Britain, on the 18th February 1859.[1] In principle, as already pointed out, it differs entirely from Dr Cammann's binaural stethoscope, although Dr Alison, in the construction of his differential stethoscope, has availed himself of the admirable mechanism of Dr Cammann's very valuable instrument. Dr Alison's differential stethoscope, so called because it enables us to differentiate the intensity and duration of two sounds, consists of two stethoscopes entirely similar in size and shape, and joined together simply for convenience of management (Fig. II.). Each stethoscope consists of a tube, which is composed of two united parts, a metallic (A) and an elastic one (B). To the free extremity of the metallic tubing, made of German silver, is attached a small ivory knob for insertion into the meatus auditorius externus (C). The free extremity of the elastic tubing —constructed for the purpose of flexibility—of spiral iron wire covered with cloth and woven silk outside, ends in a small wooden cup (D), like that of the uniaural stethoscope, which serves to collect sound. The two stethoscopes are connected by a jointed metallic bar (E), which is attached to the two metallic tubes about an inch from where they join the flexible tubing. Each stethoscope is about $16\frac{1}{2}$ inches long, the metallic tubes being about 9 inches, the flexible tubes about 6 inches in length, and the wooden cup an inch or an inch and a quarter. The ear knobs are about one-third of an inch long. The metallic tube, when viewed anteriorly, curves gently outwards (*a*) and then inwards (*b*), and, at its upper part, somewhat forwards (*c*). The forward curve is given to the instrument in order that the ear knobs may fit into the meatus auditorius externus, the direction of which is from behind forwards, and slightly inwards. The diameter of the tubal canal is about one-eighth of an inch. The cups of the differential stethoscope, like the cup of the uniaural instrument, collect sound, which is transmitted through the metallic and flexible tubes to the ears. The flexible tubing ensures greater mobility, enabling the auscultator to separate the two stethoscopes wider apart than could be effected if the instrument were inflexible. Moreover, it makes the stethoscope more portable, and, as I shall presently point out, it allows us to verify the relative correctness (*i.e.*, the equality of conducting power) of the two divisions of the differential stethoscope, in regard to the transmission of sound. The metallic tubes serve the purpose of steadying the instrument, and act as fixed points for the insertion of the connecting bar and the elastic band (F). The ivory knobs are placed in the meatus auditorius externus, and are kept in position by the elastic band pressing from without on the metallic tubes. The connecting bar joins the one stethoscope to the other; while the movable joint at its middle allows of the

[1] Professor Tyndall had previously, in April 1858, communicated to the Royal Society of London some remarks on Dr Scott Alison's differential stethoscope.

metallic tubes, and thus of the ear knobs, to be separated, and then brought together so as to fit into the ears.

Perhaps the cheapest and simplest manner of constructing a differential stethoscope, is to take two indiarubber tubes, each of about one-fourth of an inch in diameter, and a foot and a half long. Into one extremity of each tube we insert a small wooden cup, like the cup of the ordinary stethoscope; into the other, a small wooden tube, rounded at the point, about half an inch long and one-sixth wide. Our differential stethoscope is then complete. We have simply to insert the knobs into our ears, and then to place the cups on the patient's chest. Each wooden knob when inserted into the meatus auditorius externus can easily support the light weight of indiarubber tubing, and the wooden cup attached thereto. We shall now pass on to the manner of *using the differential stethoscope.*

The manner of adjusting the differential stethoscope for use is as follows:—We lay hold of each metallic tube at about its middle, and separate it from its fellow sufficiently to allow the ear knobs to enter the ears. We then gently push the ivory knobs, which are slightly bent from behind, forwards into the meatus auditorius externus. The elastic band will keep the two metallic tubes as well as the ear knobs in position. The auscultator's hands being thus free, he lays hold of the left cup with his left thumb and index finger, and of the right with his right, and then places the cups upon such parts of the thorax as he desires to examine. When the stethoscope is applied to the chest, the connecting bar is situated a little in front of the auscultator's eyes, the instrument being thus placed at a right angle to his body. The auscultator may move his head up or down, without in the least interfering with the acoustic properties of the instrument. During the whole of the examination, the cups must be held firmly and steadily, so that the entire rim should press upon the skin.

Method of Auscultating the Chest with the Differential Stethoscope.—It is best to begin by placing both cups below one clavicle. After natural respiration, the patient should be directed to take a full breath, then to cough, and then to breathe again. Lastly, the voice, first loud and then whispered, is listened to. We then, in the same manner, examine the whole apex of the lung by placing one cup above the clavicle, and the other cup above the spine of the scapula. After that, we listen to the respiration by placing both cups over the scapular region, then over the infrascapular, then over the axillary, then the mammary, and, lastly, the inframammary. The second lung is then auscultated in the same way as the first. And, so far, the only benefit we have derived from the use of the differential stethoscope is, that we hear sounds better with it, and that we have instituted an examination of the chest in much less time than with the uniaural instrument. But then Cammann's binaural stethoscope serves the same purpose equally well. It is, however, when we come to compare the two sides of the chest at

the same time that the value of the differential stethoscope is best observed and appreciated. Each lung having been examined apart, we now proceed to examine the two together. Firstly, one cup of the differential stethoscope is placed under one clavicle, and the other cup below the other clavicle. When we have done listening to those parts, we place the cups over the two upper scapular regions. We then pursue the same mode of examination with the lower scapular, and then with the mammary regions. The two axillary and infra-axillary regions cannot be listened to at the same moment, because the flexible tubes of the differential stethoscope in ordinary use are too short for the purpose.

Now, whenever we listen to the respiration of both lungs at the same time, we must hear the ordinary breathing first; then forced respiration; then forced respiration after a cough; and, lastly, the thoracic voice, whispered as well as loud. The differentiation of sound in disease, and the clinical application of the differential stethoscope, will be considered later on. At present a comparison must be instituted in regard to the

Advantages which the Differential Stethoscope possesses over other Instruments used in Auscultation.—Before proceeding to compare the differential stethoscope to other instruments used in auscultation, it must be remembered that we have three distinct kinds of stethoscopes in clinical use—viz., 1*st*, The ordinary uniaural stethoscope, which conveys sound from one part of the chest to one ear—the sound (except in flexible uniaural stethoscopes, which are hardly ever used) being conducted by the material of which the stethoscope is constructed, a fact which may be demonstrated in two ways, either by plugging the canal of the perforated stethoscope with paper or cork, or by using a solid stethoscope (*i.e.*, an unhollowed one), in both of which cases we hear nearly[1] as well as with the hollow unplugged instrument.

2*d*, Cammann's binaural stethoscope, which conveys sound from one spot to both ears simultaneously. The column of air contained within the hollow of the instrument is the conductor, and the proof of this is, that we hear nothing if we plug the canal with a bit of paper or cork, thereby arresting the vibrations of air.

3*d*, The differential stethoscope, which conveys sound from two parts of the chest to two ears respectively—*i.e.*, sounds from one point to one ear, from another point to the other ear; for the two stethoscopes of which the differential instrument consists are acoustically separate, although mechanically connected. In this instance also air is the conductor of sound. Now, the ordinary uniaural stethoscope, of whatever shape, size, or material, can generally be replaced by the unaided ear, compared with which it presents few

[1] A hollowed stethoscope, when made of wood, conducts sound somewhat better than an unhollowed one, because the woody fibre vibrates easier in the former. The difference must be slight indeed, for, if I mistake not, an unhollowed instrument is now generally used in Berlin.

advantages—unless auscultation of a limited spot is required, and always excepting those cases where feelings of delicacy or of cleanliness, rarely both, make it desirable to place a certain distance between the head of the physician and the chest of the patient.

With Cammann's stethoscope lung sounds are heard louder, clearer, and fuller than either with the uniaural instrument or unaided ear; and this is due not only to our hearing with two ears instead of one, but also because air is a better conductor of sound which has been produced in air, than it is of sound produced in a solid body, such as the heart. Thus, heart sounds and valvular murmurs are heard clearer and louder with the ordinary uniaural stethoscope than with Cammann's, while pulmonary sounds are heard better with the latter instrument.[1]

With the differential stethoscope also lung sounds are heard louder, fuller, and clearer than with any other instrument, except Cammann's, to which, however, it is not inferior in this respect. When two sounds are simultaneously conveyed by means of the differential stethoscope from one point to one ear, from another point to the other ear, and when the two transmitted sounds differ in intensity, the louder one only is heard,—the ear to which the weaker sound is conducted receiving no acoustic impression whatsoever. A very slight difference in the intensity of the two sounds is sufficient to make the minor sound quite inaudible. Now, this law is applicable to sounds of like quality only, for if they differ in this respect, although one sound may be much louder than the other, both are audible. If, for instance, we have one tube of the differential stethoscope conducting a feeble rubbing sound to one ear, and the other tube conducting a loud whistling or gurgling sound to the other ear, we shall hear both sounds at once. The one sound will not be able to drown the other, for the reason that it differs from it in quality. When, however, there is simply a difference in intensity—as, for instance, between vesicular and puerile respiration —then we hear the louder sound only.

The importance to the physician of a knowledge of this acoustic law cannot be overestimated. How well aware is every auscultator that one of the greatest and most common difficulties he encounters in his art is to decide which of two sounds is the louder! He may have listened to one sound but a few moments before he listens to the other, and yet, during that short space of time, the

[1] It is somewhat strange to find such a careful observer as Dr Flint stating that "the binaural stethoscope as devised by Dr Cammann is vastly superior to other stethoscopes in auscultating the sounds from the heart as well as from the lungs."—*A Practical Treatise on the Diagnosis, Pathology, and Treatment of Diseases of the Heart*, by Austin Flint, M.D., second edition, Philadelphia, 1870, p. 58. This is contrary to the experience of, so far as I am aware, every auscultator who has used Cammann's stethoscope—or the differential one, for that part of it—in heart disease. It may more justly be said of all flexible stethoscopes, that they are as superior to the ordinary instrument in conducting pulmonary, as they are inferior to it in conducting cardiac, sounds.

intensity of the acoustic impression has had time to die out of his mind,—to such an extent, at any rate, that he is unable to pronounce positively which of the two sounds is the greater. I have on more than one occasion heard two good auscultators disagree as to whether respiration was weaker in the right or in the left chest. The differential stethoscope generally proved that it was equal on both sides.

The great advantage of the differential stethoscope, therefore, over all others is, that by allowing us virtually to place each ear on a different part of the chest at the same time, it enables us to differentiate sound easily, *i.e.*, to recognise the stronger from the weaker. By its means respiration and vocal resonance are heard louder and clearer than with any other stethoscope—Cammann's, which equals it, excepted; and with its aid we can auscultate the chest much quicker and with less fatigue to the patient, as well as ourselves, than either with the uniaural or Cammann's instrument.

Thus, with the two cups the supraclavicular and the upper scapular region can be auscultated at once; by placing the cups side by side over any other region, we hear the breathing over double the surface that we do with any other instrument; and, lastly, we can keep our head in an easy position while examining the patient.

I have dwelt thus long upon the physical properties of the differential stethoscope, and have even risked occasional repetition, because I think these properties should be thoroughly understood before passing on to a consideration of

The Value and Uses of the Differential Stethoscope in the Diagnosis of Chest Diseases.—The differential stethoscope, while useful in the diagnosis of all pulmonary disorders, is most valuable in its application to phthisis in the first and third stages of that affection, —in those stages, viz., where not unfrequently a just comparison between the relative intensity and duration of two sounds affords us the only means of arriving at a correct opinion regarding the state of the lungs. Let us, to begin with, take the first stage of phthisis, in which there may be a change, 1st, in the intensity of the vesicular murmur; 2d, in its duration; 3d, in its quality; 4th, in its rhythm; and, 5th, in its pitch.

Now, any alteration in the quality, rhythm, and probably pitch, of the respiratory murmur, can be as well detected with the ordinary stethoscope as with the differential one. It is when we have to estimate the *intensity* and *duration* of pulmonary sounds that the differential stethoscope affords us such marked assistance. It will therefore be necessary to enumerate briefly the changes which the breathing undergoes in regard to strength and length. Thus, the ordinary vesicular respiration may, on the diseased side, be altered in intensity and duration in the following manner:—

1*st*, Both inspiration and expiration may be *harsh*. 2*d*, Both inspiration and expiration may be *feeble*. 3*d*, Inspiration may be normal, while *expiration is prolonged*. 4*th*, Inspiration may be

normal, while *expiration is prolonged and harsh.* 5*th*, Inspiration may be *feeble*, while expiration is *prolonged.* 6*th*, Inspiration may be *feeble*, while expiration is *prolonged and harsh.* 7*th*, Inspiration may be *harsh*, while expiration is *prolonged.* 8*th*, Inspiration may be *harsh*, while expiration is *prolonged* and *also harsh.*

Now, the more practice a physician has had in auscultation the better is he aware of the great difficulty, and, in the majority of cases, impossibility of detecting any of the above-named changes—except prolonged expiration—in the respiratory murmur with the aid of the uniaural, or even binaural stethoscope. With the differential stethoscope, however, there are hardly any difficulties encountered, for only the louder sound of the two actually conveyed produces an acoustic impression.

In the *first* place, then, *inspiration as well as expiration may be harsh.* When respiration is harsh and the differential stethoscope is used, we hear sound with that ear only which is connected with the diseased side, the ear connected with the healthy lung hearing no sound whatsoever. With the ordinary stethoscope, as well as with Cammann's, harsh respiration can be detected, but only when it is very intense. To prove the difficulty of discovering mildly harsh respiration, when unable to auscultate two lungs at once, we place both cups of the differential stethoscope under one clavicle first, and under the other afterwards. With even the greatest care and attention we are unable to state which of the two is the harsh-breathing lung. But if we shift the one cup of the differential stethoscope to the subclavicular region of the other lung—leaving the other cup over the old spot—we shall, instead of hearing sound with both ears, hear respiration with only one ear, viz., the ear connected with the diseased side. It sometimes happens, however, that respiration is puerile or compensatory on the healthy side, owing to tubercular deposit in the diseased lung. How, then, are we to distinguish between the harsh respiration of diseased pulmonary tissue, and the supplementary or puerile breathing of healthy structure? This is very easily accomplished in most cases, for harsh breathing—the inspiratory as well as expiratory acts—is shorter than vesicular respiration, which is shorter than puerile. Harsh respiration commences at the same moment as vesicular, but it ends earlier, and with the result that the vesicular murmur, unheard previously—*i.e.*, while the harsh breathing continued—becomes audible upon the cessation of the louder and pathological sound. Thus, suppose harsh respiration is conducted to the left ear: that ear hears, firstly, the loud inspiratory murmur, then the expiratory murmur, and, as soon as the latter ceases, the right ear, which has been dead to all sound during the preceding part of the respiratory act, hears the expiratory sound of the healthy side. If there be very harsh respiration on one side, and weak puerile breathing on the other, then the difference in regard to duration becomes very marked, for puerile is generally more protracted than

vesicular respiration. But, generally, harsh breathing is entirely masked by puerile, both in intensity and duration. Thus, in puerile breathing we never hear any portion of the respiratory act of the opposite side, whereas in harsh respiration we hear the vesicular expiratory murmur of the healthy side after the harsh expiratory act of the diseased side has ceased.

Secondly, Inspiration as well as expiration may be weaker on the affected than on the healthy side. In such cases we hear inspiration and expiration with that ear only which is connected with the healthy lung, the other ear receiving no acoustic impression whatever.

How, then, do we distinguish harsh from weak respiration? How, supposing we hear sound with one ear and nothing with the other, are we to know which ear is connected with the affected, which with the healthy side?

By the simple test that harsh respiration is shorter in duration than vesicular, so that when at first but one ear hears both inspiration and expiration, and then the other hears but a portion of the expiratory murmur of the same respiratory act, we may be sure that the ear to which sound was first conveyed is the ear connected with the diseased lung, and listening to harsh breathing. When, however, we hear inspiration and expiration with only one ear, the other ear hearing absolutely nothing, then the latter is the ear connected with the diseased lung, the respiration of which is feeble.

Harsh respiration is of greater value as a diagnostic sign when present on the right side, for it is sometimes naturally harsh on the left.[1] Indeed, several eminent auscultators assert that the respiratory murmur is almost always louder on the left than on the right side.[2]

It sometimes happens, however, that respiration is but slightly exaggerated in the diseased lung, and, further, that it does not terminate any sooner than the vesicular respiration of the other side. How, in such a case, when there is a difference simply of intensity between the respiratory murmur of the one side and of the other, are we to determine which of the two is affected? How, in other words, are we to know whether the sound conveyed to one ear is the harsh sound of diseased lung drowning the healthy breathing of its fellow,—or whether it is the vesicular respiration of healthy

[1] Physical Examination of the Chest in Pulmonary Consumption, by S. Scott Alison, London, pp. 8, 9.

[2] "Excess of loudness of *inspiration* is pretty frequent on the left side."—*A Practical Treatise on the Diseases of the Lungs*, by W. H. Walshe, 3d edition, p. 101.

"The murmur of the left lung, with scarcely an exception, if there is any difference in intensity, is distinctly louder than that of the right."—*A Treatise on the Diagnosis and Treatment of Diseases of the Chest*, by W. Stokes, Dublin, p. 394.

Unfortuuately exceptions do occur, and it not unfrequently happens that respiration is louder on the right side, when no disease exists on either. Indeed, weakness or harshness of respiration, *per se*, should make us suspect phthisis only when the constitutional symptoms are of very serious import.

lung overpowering the weak respiratory murmur of the other and diseased side? I think it is impossible to do so, particularly if the harsh respiration is on the left side. Practically, however, the great thing to recognise when we suspect phthisis is the existence of a difference between the respiratory murmurs of the two sides—the exact seat of pathological change, whether in the right or left lung, being a matter of really secondary importance. The alterations—by far the most important—in the respiratory act which we have next to consider, are those in which natural, or harsh, or feeble inspiration is associated with either simple prolonged expiration, or with harsh as well as prolonged expiration. Indeed, prolonged expiration is a sign so valuable of itself that it has very justly been considered, not only by its discoverer Dr Jackson, jun., but also by such authorities as Fournet, Louis, Thompson, Alison, Cotton, and others, as one of the most trustworthy of the asucultatory phenomena observed in the first stage of consumption.[1] When the expiratory murmur becomes altered from the healthy standard, it first undergoes a change in intensity, becoming louder and harsher, and then in duration as well, becoming more prolonged. Now in vesicular respiration the expiratory is not only weaker than the inspiratory murmur, but it is not audible unless we concentrate our attention more than is necessary for hearing inspiration; whereas in disease expiration becomes not only as intense as the inspiratory sound, but often even very much more so.[2] Thus, while expiration in health is, according to several authorities, from two to four times weaker than inspiration, in disease this order is reversed. The duration also of respiration changes, and instead of being, as in vesicular breathing, one-fourth[3] the length of inspiration, it frequently becomes twice as long as the latter.

It sometimes happens that in puerile respiration of healthy lung, the expiratory murmur is somewhat prolonged, but in these cases expiration is invariably shorter than inspiration.[4]

[1] "You will occasionally find it stated, even in writings of some authority, that prolonged expiratory murmur is a sign of doubtful value, and not to be relied on; but when reasons are given for this assertion, you will find them unsatisfactory. If no symptom of disease were to be regarded which did not require to be accepted with some qualification, and interpreted with discrimination, the science of diagnosis would dwindle into childishness."—*Clinical Lectures on Pulmonary Consumption*, by Th. Thompson, London, 1863.

[2] Dr Walshe states, that "the expiratory sound in one out of every four persons, especially at the left side of the chest, is actually inaudible."—Op. cit. p. 96. If the differential stethoscope were used instead of the ordinary one or the unaided ear, I have no doubt expiration would have been less frequently inaudible.

[3] Fournet (*Recherches Cliniques sur l'Auscultation*) expresses the intensity and duration of the healthy inspiratory murmur as 10, while the expiratory is 2. In disease, inspiration may sink from 10 to 0, while expiration may rise to 20.

[4] Prolonged expiration may also be occasioned by, 1*st*, the long, cavernous, dry respiration of some cavities; 2*d*, bronchitis; 3*d*, asthma; 4*th*, all obstructive diseases of the larynx and trachea. When due to the existence of a vomica, there is generally dulness on percussion, flattening of the chest, and whispered voice; when to any other of the above-mentioned causes, the expiratory murmur is prolonged equally on both sides.

Now, a comparison between the intensity and duration of the inspiratory and expiratory murmurs of the same side can be as well made out by the ear singly, or by any uniaural or binaural stethoscope, as by the differential instrument, simply because one sound quickly succeeds the other; and the auscultator, not being obliged to shift his stethoscope, can thus easily compare the two sounds, the acoustic impression produced by the first not being forgotten before hearing the second. But when we come to compare the intensity and duration of the inspiratory and expiratory murmurs of two different sides at the same time, then we have to resort to the differential stethoscope. And in this case, as in all others where the differential stethoscope is used, the same law holds good, viz., that of two sounds of like quality, the louder one only is heard. Suppose that in the left lung *inspiration is normal, while expiration is simply prolonged without being harsh.* One cup of the differential stethoscope is placed either below the clavicle, or above the scapular spine; the other on the corresponding part of the opposite side. The respiration of both sides being equal in intensity, we hear, firstly, the inspiration sound with both ears; then we hear expiration in the same way; and then all sound ceases in one ear, while the continuation of the expiratory murmur is heard by the other. The ear which hears the expiratory murmur when its fellow hears nothing, is the ear connected with the diseased side.

Again, *inspiration* may be *normal* on the affected side, while *expiration is both prolonged and harsh.* What do we hear with the differential stethoscope in such cases? Inspiratory murmur is conveyed to both ears simultaneously. As soon as that ceases the expiratory murmur follows; but this is heard by only one ear, the other ear perceiving no sound at all. The expiratory murmur, moreover, is longer and louder than the inspiratory which preceded it. The ear to which expiration is conducted is the one connected with the diseased lung.

Again, *inspiration may be weak, while respiration is prolonged.* In this case inspiration is heard by only one ear, viz., the ear connected with the healthy lung. Expiration is heard by both ears at first, and then it ceases in one ear, and continues to be heard by the ear which had been deaf to the sound of inspiration. The ear which heard no inspiratory sound, and only heard expiration after it ceased to be audible to the other ear, is connected with the affected side.

Further, *inspiration may be weak, while expiration is prolonged and harsh.* In such a case, we hear the inspiratory sound with the one ear, and the expiratory sound (which is louder and longer than the preceding) with the other ear. One ear is deaf to inspiration, the other to expiration. The ear to which inspiration is conducted is connected with the healthy side, the ear to which expiration is conducted is connected with the diseased side. This alternation of inspiratory and expiratory sound is very curious and striking.

Then, *inspiration may be harsh, while expiration is prolonged.* Here only one ear hears the inspiratory sound; both ears hear the expiratory murmur, and, again, only one ear hears expiration, viz., the ear which heard inspiration.

And, eighthly and lastly, *inspiration may be harsh, while expiration is prolonged and harsh.* In this case both sounds of respiration are heard by only one ear, viz., the ear connected with the affected side.[1] We can easily distinguish this acoustic condition from the simply harsh inspiration and expiration, by the length of the expiratory murmur, which is sometimes more than twice as long as the inspiratory.[2]

In conclusion, I may observe that I have never seen an alteration in the inspiratory murmur without some change in expiration. Normal expiration, with abnormal inspiration, so far as my experience goes, either does not exist, or, if it does, is so slight as to escape detection,[3] with even the differential stethoscope.

For detecting the signs which accompany the second stage of phthisis, the differential stethoscope does not prove of such value as in the first and third stages of that disease. Humid crepitation, or the subcrepitant rhonchus, however, is better heard with the differential stethoscope than with the single one, the sound being clearer and fuller. Moreover, the deficiency, generally well marked, of respiration at the base of the diseased lung is ascertained very clearly by Dr Alison's instrument. Thus, if humid crackling be discovered at the apex of the right lung, and the cups of the differential stethoscope be placed respectively over the bases of both lungs, we shall hear loud breathing—puerile, perhaps, because of compensatory action—with the ear connected with the left (healthy) lung, while no sound whatever will be heard by the ear connected with the right or diseased lung. But humid crepitation is so easily heard by the unaided ear or the uniaural stethoscope, that the differential stethoscope is of comparatively small assistance in detecting it.

When bronchial respiration exists, the ear connected with the healthy lung hears nothing, while the other ear hears loud tubular breathing, which sounds so intense through the differential stethoscope as to partake somewhat of the character of blowing respiration.

[1] Of course, the value of prolonged expiration as a sign of phthisis will be very much enhanced if, in addition to it, we hear humid crepitation, or sibilant rhonchus, or when (the left lung being affected) we hear the whiff of the pulmonary artery at the second and third left costal cartilages, or, lastly, when (the right lung being diseased) we distinctly hear the heart sounds under the right clavicle, and sometimes even at the apex of the right lung posteriorly.

[2] Harsh respiratory sounds generally exist at the commencement of phthisis, but later on these sounds become weaker, instead of being louder, than the healthy standard.

[3] The same thing has been observed by Fournet in regard to bronchial breathing: "Jamais je n'ai vu le caractère bronchique, normale ou morbide, exister *pendant l'inspiration seulement.*"—*Recherches Cliniques sur l'Auscultation*, p. 58.

Where the differential stethoscope is of greatest use, however,—always excepting the first stage of phthisis, in which it is invaluable,—is in those cases of the third stage of consumption, where a dry and silent cavity exists. Of course, the diagnosis is simpler here than in the first stage, for we have inspection, percussion, and vocal resonance to bring to our aid. But the percussion sound is not always altered, and may occasionally even be clearer on the diseased than on the healthy side, while inspection sometimes fails to detect any difference between the two chests. The alteration of vocal resonance is a more trustworthy sign, however—in dry cavities at any rate—and reference to its detection by the differential stethoscope will be made further on.

What must be borne in mind in regard to nearly all cavernous sounds is, that they are deficient in fulness and duration—particularly the former—when compared with vesicular breathing. Thus, if we place one cup of the differential stethoscope over a dry vomica, while the other cup is placed over sound lung, we shall, in the majority of cases, hear vesicular respiration with the ear connected with the healthy side of the chest, while the ear connected with the diseased side will perceive nothing. If, however, there be gurgling in the cavity, or sawing or creaking or moaning sounds, then we hear them as well, but they are much weaker in intensity and of shorter duration than the vesicular breathing heard by the other ear. In some exceptional instances, the blowing or sawing or grating sounds may be so loud as to mask the vesicular respiration, particularly if it be feeble, on the healthy side. In such cases we hear the pathological sound with the ear connected with the diseased lung, while no sound is conveyed to the ear connected with the healthy lung. Indeed, it is not where cavernous gurgling or creaking is present that the differential stethoscope is of much value—for these signs are easily enough detected by any auscultatory instrument—but it is in cases where the cavity sound is weak and dry, and inaudible to the unaided ear or ordinary stethoscope. In fact, if there be any moist cavernous sound present, then the differential stethoscope is comparatively useless, for we can hear these sounds very well without its aid. In dry cavities, on the other hand—and these are sometimes as difficult to diagnose as the silent cavities (simply from the absence of anything precise or defined in their nature)—the instrument is invaluable. In what respect, it may be asked, is the differential stethoscope superior to the uniaural one for the detection of silent and dry cavities? Its great superiority lies in this, that it at once shows us which of two respiratory murmurs is more intense, and which of two voices possesses the cavernous quality. Suppose we examine the apex and infraclavicular region first of one lung, and then of the other, with the differential stethoscope. Placing one cup of the instrument above the spine of the scapula, and the other above the clavicle (the whole apex of the lung being thus embraced at once),

the patient is directed to breathe, then to cough, then to take a full inspiration, and, lastly, to say a few words loudly at first, and then in a whisper. We next place both cups under one clavicle, and proceed as before.

Now, in listening to the diseased side, we hear very weak respiratory murmur, the expiration being as feeble, or almost as noiseless, as the inspiration sound. But there is no proof as yet that the weak breathing is a pathological weakness, for it is met with occasionally in perfect health. We next auscultate the other lung, first placing both cups over the apex, and then under the clavicle, and we again hear weak vesicular respiration, but whether louder than that which we have just listened to is difficult to determine, for the acoustic impression produced by the sounds first heard has already had time to escape from our memory. When, however, we place the two cups of the stethoscope under the two clavicles, or above the two spines of the scapulæ, then the value of differentiation will be perceived. The ear connected with the cavernous lung hears absolutely nothing, the ear connected with the healthy lung hears vesicular breathing. If, however, there be a vomica with weak inspiratory and harsh expiratory murmur, then we hear inspiration only with the ear connected with the healthy lung, expiration only with the ear connected with the cavernous lung—*i.e.*, only the major sound produces an acoustic impression.

Of course, I am here referring to exceptional instances only, where a dry and almost silent vomica exists. In the majority of cases cavities give rise to harsh, loud, blowing murmur, which is distinctly audible during inspiration as well as expiration, although nearly always stronger in the latter. Both respiratory sounds are so much louder than ordinary breathing that the ear connected with the healthy lung has either no sound conducted to it (which is generally the case[1]), or it hears extremely weak vesicular respiration, whereas the ear connected with the diseased lung hears coarse blowing inspiration and expiration very distinctly. It is also worthy of remark, that in nearly all cases where a cavity exists, or where there is humid crepitation at the apex, respiration is deficient at the base. Thus, suppose blowing respiration to exist in the upper scapular region of the left side, and that it entirely drowns the vesicular breathing of the corresponding region in the right side, when we shift the two cups to the infrascapular regions respectively, we shall hear vesicular respiration with the ear connected with the right, and no sound whatsoever with the ear connected with the left lung.

[1] Apparently these cases constitute an exception to the above-named rule, according to which one sound is eclipsed by the other when they are of like quality only. But the difference in strength between the two sounds above referred to is so great that it oversteps the limits within which the rule is applicable. If, for example, a watch is applied to one ear and a drum to the other, and the latter is tapped very gently, we shall hear both the watch and the drum; but if the drum be struck sharply, its sound alone will produce an acoustic impression, while the ticking of the watch will cease being audible.

Value of the Differential Stethoscope in estimating the Intensity of Vocal Resonance.—It is not only in determining the intensity of respiratory sounds that the differential stethoscope is so useful, but it is of equally signal service in demonstrating the relative loudness of the thoracic voice. In this respect it very frequently assists us to form a diagnosis with a certainty unattainable through any other instrument.

The change of the thoracic voice in the first stage of phthisis is a physical sign of so little importance that I shall not treat of the uses of the differential stethoscope in detecting it. Indeed, when it is considered that the vocal resonance is little altered in commencing consumption, and that it may be either louder or weaker on the diseased than on the healthy side, the worthlessness of this sign needs no further comment.[1]

In the second stage of phthisis, again, the vocal resonance is of comparatively little assistance to us, although the other physical signs are of much weight. If, however, we desire to test the alteration in the thoracic voice, a frequently absent, and when present uncertain sign, we place the cups of the differential stethoscope over the posterior bases of the lungs, and in the majority of cases we shall hear the vocal resonance with the ear connected with the diseased side. It occasionally happens that the reverse of this takes place, but in such cases the respiratory murmur is deficient on the diseased side at the base, while humid crepitation is marked at the apex.

But if the alteration in the intensity of the thoracic voice is of small importance in the second stage of phthisis, and of none in the first, it is a sign of very great value in the third stage of that disease, for then it acquires a perfectly new character by passing into pectoriloquy. Now, although pectoriloquy is heard clearer, louder, and fuller with all flexible stethoscopes (*i.e.*, stethoscopes in which air is the conductor of sound) than with the ordinary instrument, yet it never produces the same impression on the auscultator's mind that it does when listened to with the differential stethoscope. The words, when the latter instrument is used, enter the ear with a sharpness, distinctness, and directness, not observable with any other instrument. The contrast, moreover, is very marked; the one lung silent, the other whispering its sad tale into the auscultator's ear, and the effect produced as striking the twentieth time as the first.

And it is not only in pectoriloquy proper, but in whispered voice also (which is sometimes well developed when pectoriloquy is absent), that the differential stethoscope so clearly indicates the

[1] As first pointed out by Dr Stokes, the thoracic voice is generally more intense over the right than over the left chest, so that its increase on the latter side should be regarded as decidedly indicative of mischief on that side. But cases have not unfrequently been observed where the thoracic voice was stronger in the left lung when the right lung was affected. The rule holds good, however, in spite of such striking exceptions.

cavity side. In those instances, however, where a vomica existed, and where cavernous voice is impaired or altogether absent, and where even whispered voice is inaudible, we hear vocal resonance with the ear connected with the healthy lung, and nothing with the ear connected with the diseased lung. But then it is not pectoriloquy, but only increased vocal resonance, or at most a very weak and modified bronchophony, which is conveyed to our ear from unexcavated lung.

In those very rare cases where pectoriloquy is the only morbid physical sign heard at the base of a lung, I consider it not only a sign of very great diagnostic value, but of itself pathognomonic of cavity.[1] In the few instances of dry cavity at the base of the lung which have come under my notice there were other physical signs to aid me in making a diagnosis, but Dr Scott Alison mentions a case where amphoric voice at the base was the only well-marked sign, and where he formed his opinion, which turned out correct, of the existence of a cavity solely upon that evidence.[2] The differential stethoscope is invaluable in these cases, for the whole whispered or full voice flows into the ear connected with the vomica, the other ear hearing nothing whatsoever.

Uses of the Differential Stethoscope in Pneumonia.—Although several authorities—Grisolle among the rest—state that the stage of arterial congestion in pneumonia is accompanied by feeble respiration, I think the majority of physicians will be more ready to agree with Dr Stokes in regarding puerile respiration, particularly "if limited and combined with fever and excitement," as the precursor of the engorgement stage. In such cases the differential stethoscope is of value, for the puerile breathing is heard by the ear connected with the diseased lung, while no sound is conveyed to the other ear.

Uses of the Differential Stethoscope in Diseases of the Heart.—All cardiac murmurs, whether endocardial or exocardial, are heard less clearly with the differential stethoscope than with the ordinary wooden instrument. The sounds, when the former is used, appear muffled, weak, and indistinct, just as they do when the heart is auscultated by the unaided ear, or with the wooden stethoscope through thick layers of clothing. But although the heart sounds, whether healthy or morbid, appear less distinct when listened to with the differential instrument than with any other, there are cases where the differential stethoscope proves indispensable. Its great utility in detecting the seat of cardiac murmurs has been well pointed out by my late masters, Dr Alison,[3] its inventor, and

[1] It is well known, and has been abundantly proved, that very marked pectoriloquy may exist where there is no cavity, but where any solid mass of medium thickness and size lies between the bronchus and chest wall, or when a bronchus is largely dilated. Of course, when pectoriloquy is heard at the base of the lung, it is caused by neither of these conditions.

[2] Physical Examination of Chest in Pulmonary Consumption, by S. Scott Alison, p. 200.

[3] Op. cit., at p. 331.

Professor Gairdner of Glasgow.[1] What difficulties, then, it may be asked, does the differential stethoscope overcome in auscultation of the heart?

Firstly, It enables us to distinguish the systolic from the diastolic murmur in those cases where—from the irregularity of cardiac action, or from the second sound being heard at the apex only and the first at the base only, or from the second sound being indistinct at the base, or from the first sound being indistinct at the apex—it is impossible to separate the two cardiac sounds. Now, with the differential stethoscope this difficulty is at once overcome, for by placing one cup over the apex and the other over the base of the heart, we have the first sound conveyed to one ear, and the second sound conveyed to the other ear in rapid succession. Thus, if we desire to know whether a murmur is systolic or diastolic, or whether basic or apicial, we can at once do so by the differential stethoscope, for the two cups of that instrument, placed respectively over base and apex, will show us whether the murmur accompanies the first or second sound, and whether it is loudest at the apex or the base. It is often impossible to ascertain with the ordinary instrument whether a murmur is louder at the base or at the apex, whereas with the differential stethoscope this can be accomplished without any difficulty.

I must again repeat, however, that all cardiac sounds, so far as loudness and clearness are concerned, are best heard with the ordinary wooden stethoscope.

Having considered the differential stethoscope in its application to the diagnosis of chest diseases, and having referred to its superiority in many cases to other stethoscopes, it will be necessary next to inquire into the disadvantages which it possesses when compared to other instruments used for auscultation. Its shortcomings are as follows:—

1*st*, It is not so portable. (By doubling the stethoscope up, however, it can easily be carried in the side coat-pocket.) 2*d*, It is more expensive. 3*d*, Inferior in detecting cardiac murmurs.[2] 4*th*, It cannot be used over the clothes of the patient.[3] 5*th*, It makes certain noises, like those produced by applying a sea-shell to the ear. (One soon gets accustomed to these sounds, however, and latterly never even perceives them; just as the eye, after a little practice, pays no attention to specks of dust scattered over the field of the microscope.)

Let us next inquire *what Precautions should be observed in Using the Differential Stethoscope*:—

1*st*, The canals of both tubes should be pervious. It sometimes

[1] Clinical Medicine, by W. T. Gairdner, Edinburgh, p. 574.

[2] Inferior in detecting the *existence*, but not the *seat* of the cardiac murmur.

[3] This difficulty can also be overcome by the use of Dr Alison's *hydrophone*. This is an indiarubber bag, filled with water, and resembling a small flattened orange. It is placed over the patient's linen, and the cups are pressed upon it, with the result that sound is clearly conveyed to the ears. The bag is about 3½ inches in diameter, and 1 inch thick.

happens that one of the canals is blocked up by the glue used in the construction of the instrument. 2*d*, Both cups should be pressed firmly and evenly upon the parts to which they are applied. 3*d*, The cups should be placed upon the naked skin, for even the thinnest covering intervening will interfere with audition. 4*th*, The cups, if we desire to compare the respiration of the two lungs, should be applied to corresponding parts of the thorax. 5*th*, The auscultator should breathe very gently himself, or else he may mistake his own pharyngeal breathing, conveyed to his ears through the Eustachian tubes, for bronchial respiration in the patient's chest. 6*th*, Both ears should be equal in auditory power. 7*th*, That during the examination of the patient the flexible tubes be stretched, and not bent, for when loose their movements give rise to sounds which resemble friction, and interfere with audition. 8*th*, The length of the elastic tubes should be at least six inches.[1] 9*th*, The elastic band should just be tight enough to keep the stethoscope in position, and not press upon the metallic tubes with a force almost great enough to push the ear knobs through the auscultator's head.

How to test the Efficacy of the Double Stethoscope.—When we hear respiration through only one tube of the differential stethoscope, the thought very often arises as to whether the audible acoustic impression may not be due to the superior conducting power of that tube. To compare it to its fellow, however, is not difficult, and the test can at once be applied. We simply cross the tubes, and change the cups from one side to the other, so that the ear which was connected with the left lung communicates with the right, and *vice versa*. If, for example, we hear respiration through the left limb of the stethoscope, and nothing through the right limb, we shall, by simply crossing the tubes, have all sound conveyed through the right tube only. It is chiefly for the purpose of testing the equality of conducting power between the two divisions of the differential stethoscope that the flexible tubing should be at least six inches long, for if the tubing is shorter, it will be impossible to cross the tubes either under the clavicle or above the spines of the scapulæ. I shall now pass on to a consideration of the

Objections to the Differential Stethoscope.—Not a few eminent physicians have emphatically protested—either orally or in print—against the use of the differential stethoscope on the ground that it intensifies the sounds it conducts, and thus gives the auscultator a wrong impression of the strength of those sounds. In all probability the severity of such condemnations would have

[1] I had occasion this year to procure four differential stethoscopes from Mr Coxeter of London, the original maker, and found that he had shortened the flexible tubing by 1¼ inch. The result is that it is impossible to separate the two cups sufficiently to allow of their being placed respectively under the sternal ends of the clavicles.

been very much softened upon a closer acqaintance with the properties and uses of the differential stethoscope; but as the same objections are constantly repeated, and as some objectors have even gone the length of asserting that the differential stethoscope *modifies* sound, I think their statements cannot be allowed to pass unchallenged.

To begin with: The first objection to the differential stethoscope is that it *increases* sound, and therefore conveys to the auscultator a wrong impression as to *intensity*. Now, to carry out this objection to its logical termination, the stethoscope which conducts sound worst ought to be the best and most trustworthy, for is not every instrument which surpasses it in conducting power an *intensifier* of sound? Ought not, therefore, Laennec's original, long, heavy stethoscope—made of mahogany, and bearing an unpleasantly close resemblance to a policeman's baton—to be preferred to the light birchwood stethoscope, shaped to the modern model, simply because the latter instrument, instead of being called a better *conductor*, might be named an *intensifier* (evidently a highly opprobrious appellation among some auscultators) of sound?

To test whether the sounds conveyed to the ears by the differential stethoscope undergo any modification, a very simple experiment is needed. Listen to a healthy chest with the ordinary stethoscope, and mark the pitch and intensity of the respiration. Then place the two cups of the differential stethoscope over the same spot, and you will have the same sound, only with this difference, that it will appear *louder and clearer*, its quality remaining unaltered, but its intensity only being increased. Then, again, the vesicular murmur—and, still more frequently, the expiratory murmur—is sometimes inaudible with the uniaural stethoscope, and also with the unaided ear, but distinctly audible with the differential stethoscope. Surely the latter instrument does not in such cases *produce* the sounds we hear. As it cannot intensify what does not exist, the only conclusion is, that it conducts sound better than the uniaural stethoscope does, just as wood conducts sound better than iron does. The impression, therefore, produced on the mind by the use of the differential stethoscope is not a wrong one in regard either to the strength or quality of the sound, but is rather a more precise and perfect appreciation of both strength and quality. The differential stethoscope, in fact, simply conveys to our ear, in a more perfect—but not exaggerated—form, the sounds produced in the chest, just as a spyglass brings distant objects nearer to our view, without in any way altering their size or appearance.

But even if the differential stethoscope were not superior to the uniaural instrument as a conductor of sound, it would still prove a most valuable acquisition to the auscultator, by virtue of its power of differentiation. Two eminent and careful clinical teachers,

Dr Hughes Bennett[1] of Edinburgh, and Dr Fuller[2] of St George's Hospital, London, have recently borne evidence to the great assistance in the diagnosis of pulmonary disease they have derived from the use of the differential stethoscope; while Dr Gairdner of Glasgow, so long ago as 1862, drew attention to the value of the instrument in detecting the seat of cardiac murmurs.[3]

Having enumerated the slight but real, and noticed the great but imaginary, disadvantages which the differential stethoscope presents when compared to the uniaural instrument, I shall bring this paper to a close. Before doing so, however, I have only to remark, that the opinions I have passed in regard to the differential stethoscope have been drawn solely from experience; and that when I first used the instrument, I endeavoured to test its value fairly and dispassionately. Thus, of the 550 cases of phthisis and other chest diseases that entered those wards of the Brompton Consumption Hospital, to which I was attached for six months as resident clinical assistant, I examined every case first with the uniaural stethoscope only, and noted down the physical signs. The next day, I auscultated the patient with the differential stethoscope, and then compared notes, and often made out with the differential what I had missed with the ordinary instrument. Moreover, I enjoyed the privilege of having my diagnosis either corrected or confirmed by the physicians to the hospital, and by its resident medical officer. Since then I have used the differential stethoscope almost daily for the last eight years in several thousand cases of chest affection, and extended acquaintance with the instrument has only confirmed the favourable opinion I had formed of it after the first few trials. Indeed, I have such faith in it, that I feel I can never conscientiously pronounce an opinion on the condition of a patient's lungs without having carefully examined them with the differential stethoscope. If I omit doing so, I know that I have not availed myself of a most important aid to diagnosis. Of course, it requires a little patience and time to master the instrument thoroughly, but then there is no instrument to which the same objection does not apply. Like all other stethoscopes, the differential one must be regarded as simply an aid to diagnosis,

[1] A System of Medicine, vol. iii., article "Phthisis Pulmonalis," by J. H. Bennett, M.D.; London, 1871, p. 565.

[2] On Diseases of the Lungs and Air-passages, by H. W. Fuller, M.D., London, p. 75.

[3] In a work on diseases of the heart, by Professor Flint of New York, so recently published as 1870, and to which I have already had occasion to refer, no mention whatsoever is made of the differential stethoscope. There is little excuse for the author if, in 1870, he was not aware of the existence of Alison's stethoscope; still less excuse if, being acquainted with the instrument, and having employed it, he withholds his opinion regarding its properties from his readers. For the same reason it is difficult to understand why Sir Thomas Watson, in the latest(fifth) edition of his "Principles and Practice of Physic," omits any reference to the differential stethoscope,—the more so, as his book professes to convey to his readers the newest methods of research up to the date of publication.

and more should not be claimed for it. But it often happens that the auscultatory signs form the strongest and most trustworthy link in the chain of symptoms, both objective and subjective, which collectively constitute our diagnosis; and it is in such cases that delicate points in auscultation are of much importance, and that an instrument which enables us to recognise these slight deviations from the natural standard of respiratory murmur proves of such extreme value.

When it is remembered with what frequency the physician is called upon to state his opinion unwaveringly in regard to the condition of a patient's lungs; when it is remembered that the dreaded disease, if present, requires to be recognised at an early date to be treated with any prospect of success; when it is borne in mind that the whole future of the patient—his place of residence, mode of life, even profession—may depend upon the verdict; and when the difficulties with which judgment is often beset are taken into account, then every auscultator will acknowledge and fully appreciate the uses of an instrument which, like the differential stethoscope, either removes or lightens not a few of those difficulties, and enables him to pronounce a decided opinion in many cases where, without its aid, he would be in ignorance, or, at best, in doubt.

ARTICLE IV.—*On the Origin of Cancer.* By ALEXANDER OGSTON, M.D., Aberdeen.

CASE.—On the 3d December 1872, at the request of her medical attendant, I visited Mrs B., aged fifty-four, who complained of a painful nodule in her right cheek. Having for a few years been in impaired health, she had in addition, for eleven months previous, suffered considerable annoyance from the sharp edge of a decaying tooth, the right middle molar in her lower jaw. To the irritation produced by this tooth she attributes the origin, in May of the above year, of the small painful tumour in the right cheek. The tumour had been gradually increasing in size, and the stinging paroxysmal pain in it had also increased to such an extent as seriously to disquiet her and interfere with her general health.

Upon examination, a tumour of about the size of a large pea was perceptible in the substance of the right cheek, opposite the situation in the lower jaw from which the offending tooth had been removed, and below the aperture of Stenon's duct. The tumour was not sharply circumscribed to the touch, and on being grasped in mass between the fingers its bulk seemed larger than as above described, but when carefully examined between the finger placed in the mouth and the thumb externally, it was apparent that there was a limited zone of indurated tissue immediately surrounding the nucleus of the growth, which latter was of firmer consistence and